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# Intra-industry trade between European Union and Transition Economies. Does income distribution matter?

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## Abstract

EU-TE trade is increasingly characterised by intra-industry trade. For some countries (Czech Republic), the share of intra-industry trade in total trade with the EU approaches 60 percent. The decomposition of intra-industry trade into horizontal and vertical shares reveals overwhelming vertical structures with strong quality advantages for the EU and shrinking quality advantages for TE countries wherever trade has been liberalised. Empirical research on factors determining this structure in an EU-TE framework has lagged theoretical and empirical research on horizontal trade and vertical trade in other regions of the world. The main objective of this paper is, therefore, to contribute to the ongoing debate over EU-TE trade structures, by offering an explanation of intra-industry trade. We utilize a cross-country approach in which relative wage differences and country size play a leading role. In addition, as implied by a model of the product-quality cycle, we examine income distribution factors as determinates of the emerging EU-TE structure of trade flows. Using OLS regressions, we find first, that relative differences in wages (per capita income) and country size explain intra-industry trade, when trade is vertical and completely liberalized and second, that cross country differences in income distribution play no explanatory role. We conclude that if increasing wage differences resulted from an increasing productivity gap between high-quality and low-quality industries, then vertical structures will, over the long-term create significant barriers for the increase in TE incomes and lowering EU-TE income differentials.



JEL Classification F13

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# 1. Introduction

This paper investigates intra-industry trade (IIT) between the European Union (EU) and countries in transition (TE) in order to find an explanation for the emerging trade patterns between both sets of countries. We test a model in which trade within the industry of different countries is vertically and horizontally differentiated. Emerging trade structures can be explained best in the absence of trade barriers. Trade in the absence of trade barriers is rare, however. Therefore we examine two panels of EU-TE trade, liberalised and non-liberalised.[1]

Underlying the model is a product-quality cycle (*Flam* and *Helpman*, 1987) that adds income distribution to the usual explanatory country variables like relative income or wage differences between countries and country size. The empirical analysis is for the years 1993 and 1997 and on four TE countries: the Czech Republic, Hungary, Poland and the Slovak Republic. The choice of the two years of comparison and of the four countries was dictated by the availability of income distribution data. We further divide trade into a panel of liberalised and non-liberalised items. The panel of non-liberalised items was continuously liberalised after 1997 while trade in the other items was liberalised in 1993 (according to the European Agreements).

The paper is organised as follows: *Section t*wo provides stylised facts on intra-industry trade and income distribution. The facts reveal a significant fraction of EU-TE trade to be vertically differentiated, and product flows between both sets of countries show a significant quality cycle. We show further how income re-distribution from poorer to richer households in TE countries influenced the distance to income distribution patterns in the EU overall and in the individual member countries. *Section three* describes the problems identified in the relevant literature. We identify controversial results in the country and industry approaches, arguing that in both cases the main reason is the missing attention either to liberalised/non-liberalised trade flows or to the different components of IIT – horizontal (HIIT) and vertical (VIIT) trade. We present a product-quality-cycle model of VIIT consisting of country factors, among them income distribution. Adopting the country approach in *section four*, we find no empirical evidence of theoretically expected results when we utilised the whole set of data. A clearer result emerges when flows are considered separately, particularly for the determinants of VIIT and HIIT in liberalised trade. Relative country differences in GDP per capita and in size show important and different effects on the share of vertical and horizontal intra-industry trade. Finally, we find income distribution patterns to influence the share of VIIT but not in the direction suggested by the perspective of the product-quality cycle. *Section five* concludes and adds some preliminary thoughts on the perspective of EU-TE trade structure.

[1] We gratefully express our thanks to *Karin Szalai* and *Peter Schäfer* for preparing the data on income distribution (Karin) and intra-industry trade (Peter). Responsibility of the study, of course, remains with us.

# 2. Stylised facts on intra-industry trade and income distribution in and between EU and TE

The integration process of TEs and EU countries has been characterised by trade integration and various features of convergence, particularly in income distribution, during the last decade.

In general, trade developments may be characterized as:

(1) increased intra-industry trade,

(2) dominance of vertical trade, and,[2]

(3) dominance of quality differences in trade.

Also, in general the characteristics of income distribution include:

(1) a redistribution of income from poorer to richer households in the TE country group,

(2) a remarkable divergence in income inequality among TE countries, and,

(3) therefore, both a convergence and divergence of inequality in TE relative to EU countries, in any case to the detriment of poorer households in TE countries.

## 2.1 Trade

Using EUROSTAT data for trade of the EU with the four mentioned TE countries we find that the share of IIT in trade in all selected categories of the Combined Nomenclature was between 20 percent for Poland and 52 percent for the Czech Republic in 1997 (Table 1), calculated with unadjusted *Grubel-Lloyd* (G-L) indices. The share increased in three out of four cases vis-à-vis the share in 1993. In the case of Poland the share remained fairly constant for the unadjusted indices neglect trade imbalances. Balanced trade is, however, a basic assumption of all models explaining IIT. Adjusted for trade imbalances (high EU surplus), the shares of IIT turned out to be remarkably higher in trade with all four countries. The adjusted IIT share for the Czech Republic, for example, was almost 20 percentage points higher than the unadjusted share, in 1993, and for Poland it doubled in 1997 compared with unadjusted shares.

Also over time, adjusted G-L indices show a significant increase of IIT in EU trade with all four TE countries as against the unadjusted indices. This very dynamic change leads us to ask what are the factors determining it. An initial answer is the possible combination of trade liberalisation (due to the trade agreements from 1992) with competitive advantages, both possibly being reflected in the high EU surplus in the

[2] See also *Landesmann* and *Burgstaller* (1997); *Aturupane et al. (*1997); *Rosati* (1998), and *Thom* (1999).

period under consideration. Since the distinction between liberalised and non-liberalised trade was most pronounced in the period 1993-1997, we split our dataset into two panels: Panel A includes all items whose trade was completely liberalised between EU and TE. They typically include industries particularly attractive to foreign direct investors (*Hunya*, 2000). Panel B includes selected items whose trade was not liberalised during the period under consideration. We selected mainly textiles and clothing where the share of outward processing trade (OPT) was an overwhelming feature of trade contracts (*Lemoine*, 1998), and foreign direct investment (FDI) played a minor role.[3] The distinction between OPT and FDI is important insofar as both strategies at the firm level influence the emergence of trade structures in a different way: investments create new production while OPT utilises existing production.

Assume now, the EU to have a pronounced competitive advantage in liberalised trade. We then would expect larger imbalances in panel A than in panel B and, consequently, higher IIT shares. Data support this expectation. IIT shares were significantly greater in Panel A than in Panel B. The adjusted G-L index took almost 100 percent in EU trade with Poland in liberalised trade but only 24 percent in non-liberalised trade in 1997. The gap between the unadjusted and the adjusted shares is by far larger in Panel A than in Panel B, and also the increase of adjusted shares turned out to be somewhat weaker in B than in A. Thus the first conclusion is: When trade is liberalised and when one side has a competitive advantage, this advantage exerts a more pronounced impact on IIT than under less liberalised conditions. Which kind of competitive advantage this might be will show the decomposition between horizontal and vertical trade structures.

The decomposition[4] shows a clear VIIT dominated trade structure (Table 2). VIIT accounted for about 76 per cent of total trade (EU-Slovakia) and 84 per cent (EU-Czech Republic) in 1997.

A competitive advantage in quality of the EU vis-a-vis the TEs materialises particularly in liberalised trade. The shares of VIIT in Panel A are much greater than in Panel B. IIT in Panel A was almost completely vertical in EU trade with Hungary – a feature that poses a question concerning the usual assessment of FDI and its structural effects. Hungary has attracted the highest FDI per capita among TE countries.[5] It is often assumed that FDI in particular, promotes IIT, and thus also advances the technological level of production, increasing productivity and income. Though FDI certainly contributes to technological upgrading, the link between this effect and catching-up in income terms, however, cannot be taken for sure when FDI establishes or hardens VIIT structures.

There are some objections to a simple interpretation of VIIT being an expression of only relative quality advantages. We roughly disentangled quality from cost advantages[6] and

3 For some data see also the Annex.

4 The VIIT and HIIT components of G-L indices are obtained by applying the usual method (see Appendix).

5 The stock of FDI per capita was in 1997 at 1,587 US dollar for Hungary, 920 US dollar for the Czech Republic, 377 US dollar for Poland and 387 US dollar for the Slovak Republic. See *WIIW*, 2001.

6 See Annex.

found almost all VIIT trade to be linked with a quality advantage of the EU in Panel A (Table 3). While a quality advantage of the TE could be identified for 1993, we found that it disappeared by 1997. Though the quality advantage of the EU also declined in trade with both the Czech and Slovak Republics, these countries could not take advantage of their improved position. The loss of quality advantage of the EU and both of the TEs turned into appropriate gains of cost advantage. The picture is quite different in Panel B. First, the quality advantage of the EU was not as great as in Panel A. Second, it tended to erode more than in Panel A. The quality advantage of the TE was obvious and increased in two out of four cases (Hungary and Slovakia).

We may draw two preliminary conclusions: (1) VIIT structures are a prevalent feature in all trade – be it liberalised or non-liberalised, but VIIT amounts to significantly higher shares in liberalised trade. (2) VIIT structures are dominated by quality advantages of the EU, which increased in liberalised trade over time. The disappearance of the TEs' quality advantage in Panel A in favour of cost advantages gives evidence of a quality-based product cycle. In this cycle, the EU specialises in production at the high-quality, and the TE in the low-quality, end of the continuum of differentiated goods.

## 2.2 Income distribution

Income is assumed to have a strong impact on the quality consumers demand. Income distribution over households then plays a role in some models explaining IIT. Using data from Luxembourg Income Studies (LIS) based upon household surveys, *Lorenz* curves[7] for TE countries during two years of observation reveal a downward shift, reflecting a re-distribution of income from poorer to richer households (Graph 1). The re-distribution was the outcome of a complex set of forces. Due to the liberalisation programmes, incomes from profit emerged as an increasingly important factor in income re-distribution (*Hölscher*, 2001). In addition, labour market deregulation led to more inequality in wages (*Milanovic*, 2000). Reforms of the tax system and strains on the pension system contributed to re-distribution.

Income differences across countries and their change due to income re-distribution in the individual countries are an important consideration in evaluating the impact of international trade. E.G., how income re-distribution in one country changes the difference against a second country, is an important issue. We may demonstrate by for the case of the Czech Republic and the United Kingdom (Graph 2). The distance between the two *Lorenz* curves in basis years 1991 (UK) and 1992 (Czech Republic) illustrates that income distribution in the UK was more unequal than in the Czech Republic. The picture changes for the year of comparison (1995/1996): more inequality in the Czech Republic reduced the relative distance to the UK income distribution.

Additional information on the change of the distance in income distribution between TE and EU countries are suggested by decile ratios – the ratio between income shares of the

[7] A *Lorenz curve* below the $45^{o}$ line reflects an unequal income distribution. A downward shift of the curve reports more inequality due to a shift of income from poorer households (lower deciles) to richer households (higher deciles).

10th and the 1st decile. Income distribution in the TE country is more equal if the decile ratio is lower than that of the EU (country). Both the Czech and Slovak Republics provide an example of income distribution being relatively equal compared with the EU in the basis year (Graph 3). On the contrary, income distribution was already more unequal in Hungary and Poland in the basis years. Re-distribution was strong between both years of comparison in all four cases, and it turned out to be stronger than in the EU.[8] There was, hence, convergence between the Czech and Slovak Republics and the EU region, but divergence between Hungary and Poland compared with the EU.

How income distribution may effect IIT, in combination with other determinants, is the subject of the next section.

# 3. A review of IIT models and test results

## 3.1 Country and industry determinants

There is a rich literature examining the relationship between trade flows and country and/or industry characteristics. The theoretical perspective behind these links is often discussed as well as their empirical implementation. These studies typically construct an index of intra-industry trade and investigate correlates of the index with country and/or industry determinants. While these studies are certainly interesting, their relationship to the theory of international trade is often tenuous and debatable[9]. An important exception is *Helpman* (1987) who developed some simple models of monopolistic competition and tested some hypotheses, which were directly motivated by the theory. The empirical literature has focused on "testing" all or a subset of the industry and country determinants of IIT predicted by theory, finding more empirical support for country than industry factors.

The "country approach" focuses on how country characteristics explain IIT (*Helpman and Krugman*, 1985; *Helpman*, 1987; *Hummels and Levinsohn*, 1995)[10]. Assuming all intra-industry trade to be horizontally differentiated, a negative relationship is expected to exist between IIT and GDP per capita differences. A positive relationship is expected between HIIT and the minimum size of a country involved in trade and a negative relationship is expected with the maximum size of the country involved in trade. Helpman found that the data support these predictions.[11]

*Hummels* and *Levinsohn* questioned the apparent empirical success of these models.

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8 Comparable data were not available for Greece and Ireland.

9 For a survey see *Leamer* and *Levinsohn* (1995).

10 In this framework, usually two types of industries are considered, one producing the homogeneous and the other producing the differentiated good. Within each type industries are equal and therefore there are no reasons to test variations across them. The industrial perspective characterizes what is here identified as the approach.

11 Alternative specifications are utilized for actual factor data versus differences in per capita income, for cross-section versus panel and fixed versus random effects.

Their estimated regression for basic comparison with *Helpman's* results is the following:

$$(1) \quad s_{jk} = \beta_0 + \beta_1 \ln\left[\frac{GDP^j}{L^j} - \frac{GDP^k}{L^k}\right] + \beta_2 \min\left(\ln GDP^j, \ln GDP^k\right) + \\ + \beta_3 \max\left(\ln GDP^j, \ln GDP^k\right) + \varepsilon_{jk}$$

where s is the Grubel-Lloyd index for the bilateral trade of a country pair, *j* and *k* , *with* $\beta_1<0$, $\beta_2>0$, *and* $\beta_3<0$. They found rather weak evidence of a negative relationship between GDP per capita differences and IIT shares in OLS regressions. When improving the explanatory power of their regressions by applying fixed effects, the sign of $\beta_1$ turned positive and remained significant. They attributed this result to the fact that the fixed effects regressions are controlling for the differences in distance and land endowments, which affect the share of intra-industry trade, finding that the distance effect[12] seems to be much stronger. They conclude in their "inconclusions" that "we find, at best, very mixed empirical support for the theory. Contrary to factor differences explaining the share of intra-industry trade, much of intra-industry trade appears to be specific to the country-pair".[13]

The basic message is that fixed effects estimates drastically change the empirical role of factor and income differences[14], an effect emerging clearly even with random effects estimates. The very mixed empirical support for the theory suggest that much intra-industry trade appears to be specific to country-pairs rather than explained by factor/income differences.

The "industry approach" forms another extensive literature on how IIT varies across industries within countries, though empirical results in search of country/industry determinants are not clearly related to the theory. *Aturupane et al.* (1997) analysed IIT in EU-TE trade, where VIIT accounts between 80 per cent and 90 per cent of total IIT, focusing on industry-specific determinants, and expecting country factors to be particularly important for HIIT. This was, however, not the case. Only 1 out of 5 tested industry determinants yielded the expected sign for VIIT, in two cases the odd sign was obtained and in the remaining cases the result was hard to interpret due to the ambiguity of the expected sign. For HIIT, three of the five variables showed the expected sign. By using country dummies,[15] the explanatory power of the regressions increased significantly for HIIT, but only slightly for VIIT. The basic conclusion is that industry specific effects dominate VIIT. When vertical is empirically important for ITT, country-specific effects become irrelevant and VIIT is better explained by industry rather than

[12] The empirical success of the gravity models is well known.

[13] *Hummels* and *Levinsohn*, op.cit. p. 828.

[14] Recall the long-standing debate on whether per capita income is a proxy for factor endowments or consumer tastes. Empirical literature has interpreted differences in per capita income both as a demand side phenomenon as *Bergstrand* (1990) and as a proxy for differences in factor composition as in *Helpman* (1987).

[15] But proxies for "country specific factors" are dummies The use of country dummies is motivated by the absence of reliable data on incomes and endowments for TE countries.

country determinants.

We are now left with two problems: the first one has to do with the obvious fact that VIIT and HIIT are determined by different factors. What happens when the "country approach" takes into account the stylised facts on intra-industry trade, that is the relative importance of VIIT in TE-EU (liberalised) trade? *Hummel* und *Levinsohn* argued that the weak significance of the GDP per capita variable without fixed effects and the change of the sign with fixed effects should be explained by country-pair specifics. However, the result might also be consistent with models of intra-industry trade in vertically differentiated products. The fixed effects might control for differences across countries when VIIT, not HIIT, matters.

The second problem is linked with the identification of additional changeable country factors (instead of 'unknown' fixed effects) and with their explicit testing (instead of implicit testing via country dummies) in order to find a better explanation of trade flows variations whenever HIIT and VIIT are identified. The model of vertically differentiated intra-industry trade of *Flam* and *Helpman* (1987) for a North-South context offers an interesting theoretical perspective also for EU-TE trade by including income distribution in the pool of country factors. A brief outline will demonstrate the structure of the model.

## 3.2 A model with income distribution

The model explains the demand for different varieties of the same good due to indivisibilities in consumption and variation in income across countries. The less developed country, say: the TE, produces a homogenous good and the low-quality variety of the differentiated product whilst the developed country, here: the EU, produces the high-quality variety. On the production side, both countries have the same unit labor requirements to produce the homogeneous good but different unit labor requirements to produce one unit of the differentiated good with quality level q, a(q), a*(q), both positive and convex in the quality level. Their ratio Z= a*(q)/a(q) is assumed to increase in q so that the EU has an absolute advantage in producing all quality levels. The reason why the EU does not produce the entire quality range of the differentiated product is the possible comparative advantage of the TE in producing the low quality varieties The problem now is to identify the splitting between the two regions of the "chain" of comparative advantages, defined by quality levels with a continuum of varieties Z(q) of the differentiated commodity.

The demand for a specific variety is associated with different income levels of consumers: consumers have different effective labour endowments, and consumers with higher effective labour endowments earn higher income and demand higher quality varieties of the differentiated good. It is possible to describe the distribution of income over households by density functions for the EU and for the TE. These functions denote also the density of the distribution of effective labour endowments over households.

The model is solved for a dividing income level at which consumers are indifferent against quality, but respond to changes in the relative price of varieties. Consumers/households with higher income purchase high-quality varieties and with

lower income low-quality ones. The dividing income class determines the split of demand for quality in both countries and the relative wage rate. The explicit expression for the share of VIIT in total trade according to Flam and Helpman reads

$$(2) \qquad S = \frac{\alpha+\gamma}{\alpha+\gamma^*}\frac{wL}{w^*L^*}\frac{F(h_d)}{1-F^*(h_d^*)}.$$

where $\alpha$, $\gamma^*$ are parameters for consumer preferences and for the definition of the unit labour input functions. *F(·)* and *F*(·)* are the cumulative distribution function in the EU and in the TE, up to the consumer with the dividing income level, which is in the interval $h, h^* = [0,...h, h_d^*,...1]$. The wage rate and the labour supply are defined by *w* and *w** and *L* and *L** respectively. All EU households in the interval $h = [1, h_d]$ spend a share of $\frac{\alpha}{\alpha+\gamma^*}$ of their income *wL* for the imported low-quality variety. All TE households in the interval $h^* = [h_d^*, 1]$ spend a share of $\frac{\alpha}{\alpha+\gamma}$ of their income *w*L** for the high-quality variety produced in the EU country.[16]

The income of the consumers/households being indifferent against quality is the product of the wage ratio and the amount of effective labour offered by these households. As shown by Graph 4 with density functions *g* for EU and *g** for TE, for an arbitrary relative wage $\omega$, TE exports varieties with quality levels between $q_l$ and $q_d$ whereas the EU exports varieties with quality between $q_d$ and $q_{h..}$ Expression (2) describes how a change of the relative wage level, of the size (labour supply) and of the dividing income class influence the share of (vertical) intra-industry trade in total trade. The most interesting determinants are the changes in the relative wage and in income distribution.

Assume the EU country increases productivity in its high-quality goods industry. The wage level will follow to increase and so $\varpi$. The EU demand for the low-quality will increase ($q_d$ moves to the right) and so the share of vertical intra-industry trade. This is the income effect. *Flam* and *Helpman* show that some of the factors which affect the equilibrium relative wage (w/w*) may have indirect effects on S via a change of the dividing income level (price effect). In the case demonstrated, demand for the low-quality variety will exceed supply (since productivity in the TE remained unchanged), and the price of the low-quality variety will increase, and the wage rate w* too. The result is a fall in the dividing income level in both countries and an appropriate fall of $F(h_d)$ and $F^*(h_d^*)$. Whilst the income effect causes S to increase, the price effect causes it to decrease – the aggregate effect remains ambiguous.

Let us now assume that in the TE income distribution becomes more unequal to the detriment of the poorer households (see Graph 5), and demand for imported goods increases. Consumers in both countries now face a higher price level for $q_h$ but only the EU wage rate w would increase. EU households with the dividing income would react on higher prices for $q_h$ and shift their demand to $q_l$, produced in the TE. With a new

[16] The ratio between both shares yields the parameter term in expression (2).

dividing income class, $F(h_d)$ would increase. The same happened in the TE since part of the consumers with the dividing income shift their demand to the low quality product. Again, the dividing income increases, and $F^*(h_d^*)$ would follow. In both cases, and according to (2) the share of VIIT in total trade would be higher.

Expression (2) may be a good candidate to disentangle different determinants of both HIIT and VIIT in the EU-TE context where the EU stands for a region of more developed countries and the TE for a region of less developed ones. The model predicts that the volume and share of VIIT between two countries may be positively related to the difference in their per capita GDP (as a proxy for the relative wage assuming zero growth of labour supply) and to the distance in income distribution. *Durkin* and *Krygier* (2000) tested the model for US-OCED trade. They found the expected signs and significant coefficients for GDP per capita, income distribution and distance, but ambiguous results for the size variable.

## 4. Results

The empirical form of equation (2) is

$$s_{EU,TE} = \beta_0 + \beta_1 \ln\left[\frac{GDP^{EU}}{L^{EU}} - \frac{GDP^{TE}}{L^{TE}}\right] + \beta_2 \min\left(\ln GDP^{EU}, \ln GDP^{TE}\right) + \beta_3 \max\left(\ln GDP^{EU}, \ln GDP^{TE}\right) + \beta_4 \ln ID + \varepsilon_{EU,TE} \quad (3)$$

where $s_{jk}$ is the share (in logs) of intra-industry trade between country *j* and country *k* in total trade. As a proxy for the average wage we use the GDP per capita. The log form $\ln(GDPC_k\text{-}GDPC_j)$ reports changes in the relative difference between each pair of countries. The next variable is a proxy for changes in labour supply (or population growth) when wages are given. The variable represents the size gap between each pair of countries. Regressions were estimated with maximum values as well as minimum values. All domestic GDP data had been converted into US dollar terms based upon the average exchange rate of the prevailing year.[17] *lnID* represents a change in the distance in income distribution between each pair of countries as a proxy for a shift in the dividing income level; $\varepsilon$ is the disturbance term. The income distribution variable is calculated as bilateral relative decile ratio (see Annex). The share of intra-industry trade is calculated as total IIT, HIIT and VIIT for each panel A and B and for the entire panel (A+B). GDP per capita data were taken from OECD (2001). Regressions were estimated using OLS.

In *Hummel/Levinsohn* there is no income distribution variable, but there is a specification with fixed effects. In *Durkin/Krygier*, income distribution (though differently calculated) plays an important role and there are spatial distance plus fixed effects in addition. We neglect spatial distance due to the relatively close location of all countries in the sample, and fixed effects.

[17] For testing robustness of the estimates, we also run regressions with data in purchasing power terms. We found no major differences in results.

The theoretical predictions drawn form our model for HIIT and VIIT show

(1) opposite relationship for HIIT and VIIT if per capital GDP and capital-labour ratios are correlated,

(2) a major role for income distribution in explaining VIIT whereas it has no role in the case of HIIT, and

(3) a positive impact on VIIT if the developed country/region is significantly larger than the less developed country.

In the first stage, we estimate regressions without income distribution and compare the results with those *Hummel/Levinsohn* obtained for total IIT. *Hummel/Levinsohn* obtained a positive sign for the coefficient of the relative difference variable in explaining IIT with fixed effects regressions. Whilst the estimated importance of the relative difference for IIT and HIIT remained ambiguous, our results are clearer. Our estimates yield a positive sign for $\beta_1$ of both IIT and HIIT (Table 4, columns 1 and 2). Since the coefficient is not significant we found that differences in GDP per capita seems indeed not to have any explanatory power for IIT.

Testing for VIIT we found, like *Durkin/Krygier* a significant and positive coefficient for the relative difference (column 3). The difference in GDP per capita has a significant impact on VIIT. The split of the dataset into Panel A and Panel B confirms the picture we found for total trade. The coefficients of variables are significant for explaining VIIT in Panel A and have positive signs (column 3a). Coefficients remained insignificant in explaining HIIT (column 2a). Results do not show any explanatory result for Panel B (columns 2b and 3b). These results confirm, first, the separation of VIIT from total IIT, and second, the separation of liberalised from non-liberalised trade in VIIT. The explanatory power of the model is stronger for Panel A than for Panel B, and coefficients are mostly significant.

The second stage includes the income distribution variable in the empirical specification. We omit results on the entire Panel and focus on Panel A and B. In line with *Durkin/Krygier*, we expect GDP per capita difference to be positively related to vertical and negative or non-significant for horizontal trade. Indeed, we found no explanation for horizontal trade and, hence, due to the marginal role HIIT plays in total trade, for IIT in Panel A (Table 5, columns 1a and 2a). The picture changes for VIIT. The difference in GDP per capita has the expected positive sign and is significant for Panel A (column 3a). We expected further income distribution to have a positive effect on the share of VIIT and to be unrelated to the share of HIIT. We obtained, however, income distribution to have a negative sign and to be only weakly significant for VIIT and to be unrelated to HIIT. The explanatory power of the regression including income distribution is not remarkably higher than excluding it for Panel A.

Again, no results for B were achieved (columns 1b throughout 3b), underlining the assumption that the tested variables (excluding income distribution) have an important impact on VIIT only when trade is liberalised.

We tested the regressions for unadjusted G-L indices and found no major deviation from results obtained for adjusted indices. The low explanatory power of the regressions might be a result of some country specifics and could be improved by running regressions with fixed effects. OLS regression only for the Czech Republic and for Panel A provide some evidence for this assumption. The model explains 60 per cent of VIIT (Table 6, column 3a) with the income distribution variable negative (but significant) and relative difference again positive and significant. The explanatory power of the model including distribution is higher than excluding it. It could be mentioned here that both the Czech and the Slovak Republics are characterised by an income distribution pattern different from that of Hungary and Poland. This was possibly due to the history of Czechoslovakia, which split in 1993. Generally speaking, income distribution in the Czech and Slovak Republics tended to converge toward the EU level while it tended to diverge in cases of Hungary and Poland (recall Graph 3). The weak explanatory results of income distribution for VIIT leaves two questions yet unanswered: first, there is rather an explanation of more inequality provided by increasing VIIT, or second, more convergence in income distribution should rather explain HIIT (in the Czech and Slovak cases), the latter assumptions remain to be tested with a better dataset.

# 5. Concluding remarks

There is strong evidence that VIIT between the European Union and Transition economies was influenced by differences between countries, whenever trade was free. This result confirms the main line in the literature, pointing to the superior importance of country factors rather than industry factors for overwhelmingly vertically structured IIT.

We found further that vertical structures accounted for the major part of liberalised trade, and here, differences in GDP per capita and the size of the countries matters. Relative income distribution over time and across countries seem to be rather irrelevant. Then we may ask (neglecting possible data defects): is income distribution indeed an exogenous variable or rather does it depend on VIIT? There is a rich debate on whether and how globalisation and technology changes alter the relative demand for unskilled and skilled workers. Recent empirical research found that product-cycle driven technology transfer from advanced countries to less advanced countries seems to be a source of skill upgrading and rising (wage) inequality in both regions (*Chun Zu*, 2000).

What remains really interesting from the product-quality cycle model is the wage difference between both countries. We found the proxy – the GDP per capita – to have a significant and positive influence on the share of VIIT. Let trade start in a situation of given differences in skill endowment in EU and TE. If the EU were able to improve productivity in its high-quality industry, the increasing wage rate would support more demand for low-quality goods, and then the EU can transfer product-cycle goods to the TE countries. The latter might improve productivity and wages in the low-quality industry as we have seen by hand of Graph 4. Though this were still progress compared with the situation inherited from former socialist times, the wage difference remains strong and might even increase. In that case, technical upgrading in the TE would be delinked from catching-up in productivity and income terms.

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# Annex

# Tables and Graphs

Table 1:

Grubel-Lloyd indices of intra-industry trade between EU(15) and TE (4), 1993 and 1997

| TE | year | unadjusted | adjusted |
|---|---|---|---|
| | Panel A+B | | |
| Czech Republic | 1993 | 0.383 | 0.584 |
| | 1997 | 0.521 | 0.711 |
| Hungary | 1993 | 0.366 | 0.377 |
| | 1997 | 0.412 | 0.438 |
| Poland | 1993 | 0.199 | 0.291 |
| | 1997 | 0.198 | 0.382 |
| Slovakia | 1993 | 0.236 | 0.312 |
| | 1997 | 0.291 | 0.376 |
| | Panel A | | |
| Czech Republic | 1993 | 0.304 | 0.823 |
| | 1997 | 0.497 | 0.848 |
| Hungary | 1993 | 0.408 | 0.648 |
| | 1997 | 0.539 | 0.772 |
| Poland | 1993 | 0.238 | 0.957 |
| | 1997 | 0.172 | 0.992 |
| Slovakia | 1993 | 0.254 | 0.890 |
| | 1997 | 0.352 | 0.875 |
| | Panel B | | |
| Czech Republic | 1993 | 0.506 | 0.565 |
| | 1997 | 0.563 | 0.567 |
| Hungary | 1993 | 0.355 | 0.375 |
| | 1997 | 0.372 | 0.377 |
| Poland | 1993 | 0.164 | 0.175 |
| | 1997 | 0.229 | 0.243 |
| Slovakia | 1993 | 0.221 | 0.264 |
| | 1997 | 0.230 | 0.270 |

Source: Own calculations based on EUROSTAT. Data for EU(15) 1993 include data for Austria, Sweden and Finland from 1995.

Table 2:

Grubel-Lloyd indices of vertical intral-industry trade between EU (15) and TE (4), 1003 and 1997

| TE | year | unadjusted | adjusted |
|---|---|---|---|
| | Panel A+B | | |
| Czech Republic | 1993 | 0.320 | 0.487 |
| | 1997 | 0.435 | 0.594 |
| Hungary | 1993 | 0.292 | 0.301 |
| | 1997 | 0.338 | 0.359 |
| Poland | 1993 | 0.175 | 0.256 |
| | 1997 | 0.152 | 0.295 |
| Slovakia | 1993 | 0.185 | 0.245 |
| | 1997 | 0.221 | 0.285 |
| | Panel A | | |
| Czech Republic | 1993 | 0.297 | 0.803 |
| | 1997 | 0.474 | 0.808 |
| Hungary | 1993 | 0.407 | 0.647 |
| | 1997 | 0.537 | 0.769 |
| Poland | 1993 | 0.228 | 0.917 |
| | 1997 | 0.166 | 0.955 |
| Slovakia | 1993 | 0.244 | 0.854 |
| | 1997 | 0.318 | 0.791 |
| | Panel B | | |
| Czech Republic | 1993 | 0.356 | 0.397 |
| | 1997 | 0.367 | 0.370 |
| Hungary | 1993 | 0.264 | 0.278 |
| | 1997 | 0.276 | 0.279 |
| Poland | 1993 | 0.128 | 0.137 |
| | 1997 | 0.135 | 0.143 |
| Slovakia | 1993 | 0.134 | 0.160 |
| | 1997 | 0.123 | 0.144 |

Source: Own calculations based on EUROSTAT. Data for EU(15) 1993 include data for Austria, Sweden and Finland from 1995.

Table 3:

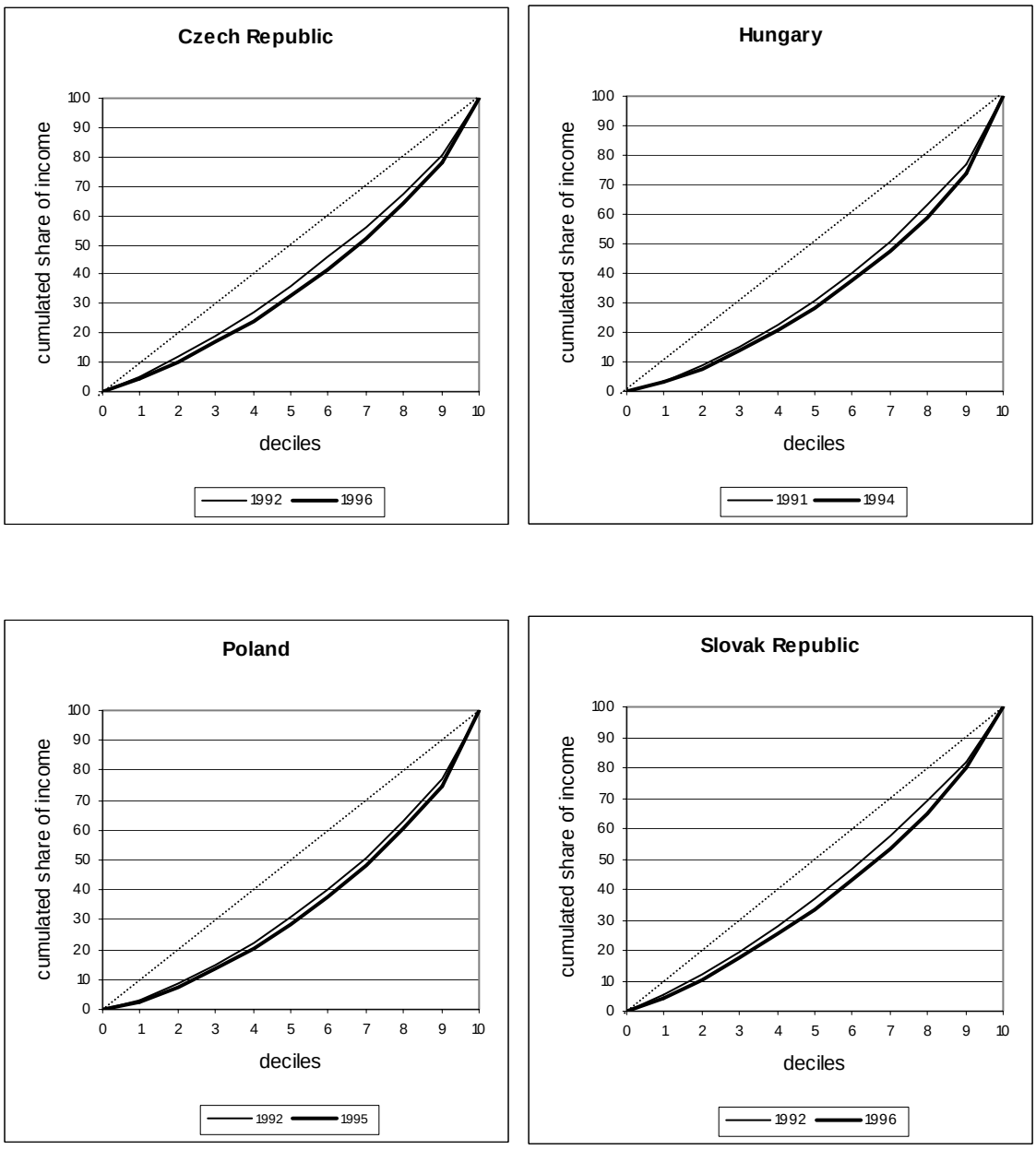
The distribution of quality-based VIIT between EU and TEs (adjusted G-L indices)

| TE | year | EU | TE |
|---|---|---|---|
| | Panel A+B | | |
| Czech Republic | 1993 | 0,328 | 0,027 |
| | 1997 | 0,583 | 0,001 |
| Hungary | 1993 | 0,084 | 0,114 |
| | 1997 | 0,143 | 0,131 |
| Poland | 1993 | 0,148 | 0,043 |
| | 1997 | 0,206 | 0,027 |
| Slovakia | 1993 | 0,193 | 0,019 |
| | 1997 | 0,191 | 0,018 |
| | Panel A | | |
| Czech Republic | 1993 | 0,655 | 0,013 |
| | 1997 | 0,583 | 0,001 |
| Hungary | 1993 | 0,258 | 0,000 |
| | 1997 | 0,558 | 0,000 |
| Poland | 1993 | 0,625 | 0,000 |
| | 1997 | 0,924 | 0,002 |
| Slovakia | 1993 | 0,748 | 0,063 |
| | 1997 | 0,584 | 0,000 |
| | Panel B | | |
| Czech Republic | 1993 | 0,195 | 0,042 |
| | 1997 | 0,201 | 0,026 |
| Hungary | 1993 | 0,065 | 0,145 |
| | 1997 | 0,056 | 0,164 |
| Poland | 1993 | 0,057 | 0,058 |
| | 1997 | 0,041 | 0,032 |
| Slovakia | 1993 | 0,105 | 0,014 |
| | 1997 | 0,071 | 0,033 |

Source: Own calculations based on EUROSTAT. Data for EU(15) 1993 include data for Austria, Sweden and Finland from 1995.

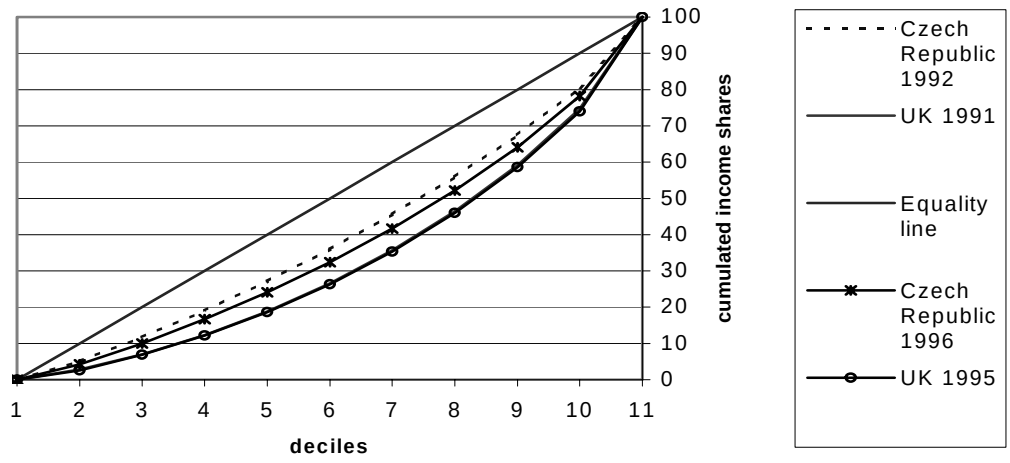
Graph 1:

Lorenz curves for the Czech Republic, Hungary, Poland and the Slovak Republic, 1993 and 1997

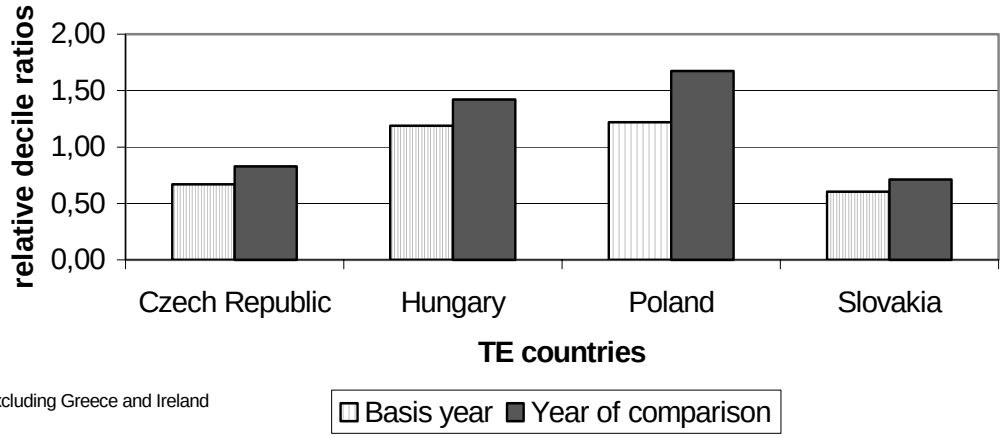



Source: Own calculation based upon LIS data.

**Graph 2: Income distribution: differences between the Czech Republic and the United Kingdom**

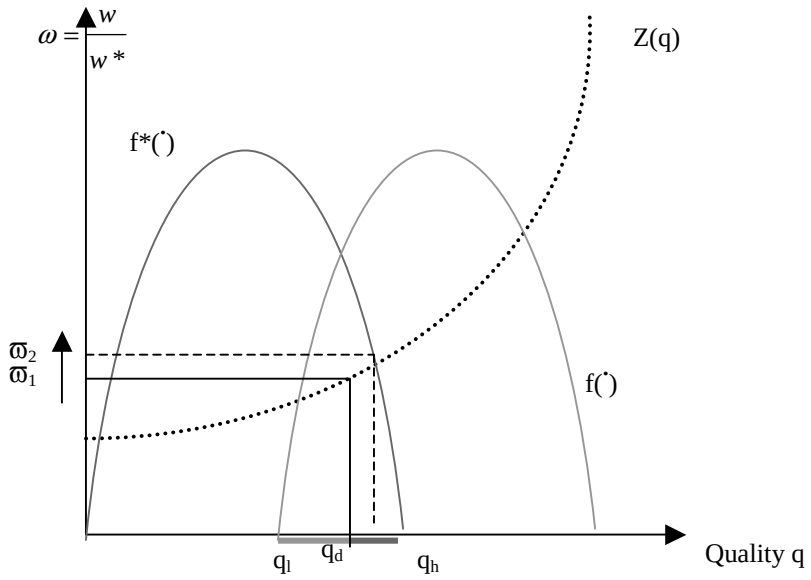



**Graph 3: Relative decile ratios (means of TE countries over EU-13 countries)***




Source: Own calculation based upon LIS data.

**Graph 4: Wage changes and the quality-split**




**Graph 5: Income re-distribution and the quality-split**

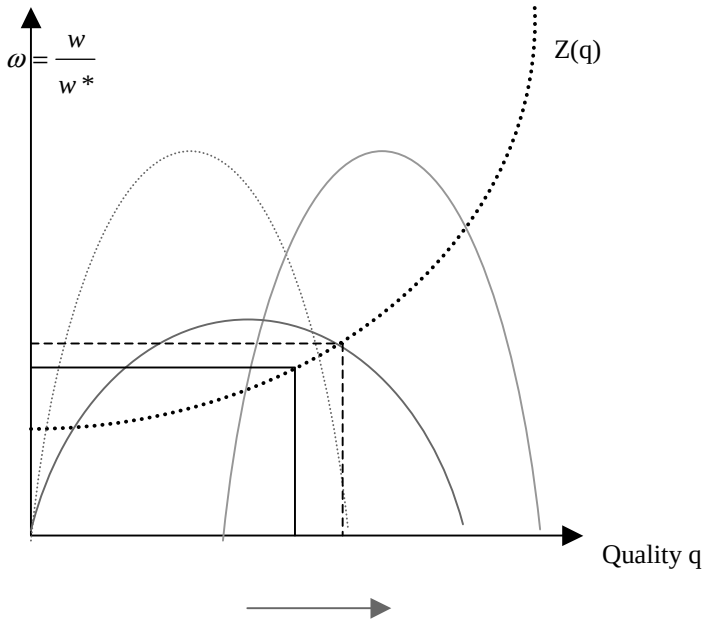


Table 4:

OLS regressions on the shares of intra-industry trade of TE countries

| Dependent variable | (1) Total IIT share | (2) HIIT | (3) VIIT | (2a) HIIT(A) | (3a) VIIT(A) | (2b) HIIT(B) | (3b) VIIT(B) |
|---|---|---|---|---|---|---|---|
| Constant | -12.723 (4.48) | -13.173 (2.282) | -13.044 (4.61) | -3.114 (0.339) | -15.985 (4.906) | -6.806 (1.150) | -6.276 (1.709) |
| ln\| $GDPC_{EU}$-$GDPC_{TE}$\| | 0.374 (1.497) | 0.273 (0.524) | 0.421 (1.691) | 0.126 (0.156) | 0.854 (2.978) | 0.422 (0.782) | 0.102 (0.315) |
| ln maxGDP | 0.223 (3.326) | 0.320 (2.421) | 0.197 (2.947) | -0.153 (0.712) | 0.274 (3.555) | 0.115 (0.887) | -0.002 (0.272 |
| ln min GDP | 0.454 (5.173) | 0.270 (1.483) | 0.456 (5.226) | 0.004 (0.872) | 0.308 (3.064) | -0.180 (0.996) | 0.365 (3.214) |
| Country-specific effect | None | None | None | None | None | None | None |
| Adj. $R^2$ | 0.30 | 0.06 | 0.29 | 0.11 | 0.24 | 0.011 | 0.081 |

Note: IIT = intra-industry trade; HIIT = horizontal intra-industry trade; VIIT = vertical intra-industry trade. The absolute value of the t-statistics are in parentheses. Each regression contains 88 observations.

Table 5:

OLS regressions with income distribution on the shares of intra-industry trade of TE countries.

*Panel A and Panel B*

| Dependent variable | (1a) Total IIT share(A) | (2a) HIIT(A) | (3a) VIIT(A) | (1b) Total IIT Share(B) | (2b HIIT(B) | (3b) VIIT(B) |
|---|---|---|---|---|---|---|
| Constant | -16.862 (5.233) | -1.322 (0.124) | -19.385 (5.182) | -7.87 (2.032) | -11.822 (1.762)) | -10.063 (2.385) |
| ln\| $GDPC_{EU}$-$GDPC_{TE}$\| | 0.798 (2.964) | 0,001 (0.015) | 1.091 (3.48) | 0.277 (0.855) | 0.770 (1.323) | 0.365 (1.036) |
| ln maxGDP | 0.215 (2.886) | -0.119 (0.503) | 0.201 (2.33) | -0.007 (0.892) | 0.000 (0.057) | -0.105 (1.074) |
| ln minGDP | 0.524 (4.201) | -0.005 (0.138) | 0.486 (3.42) | 0.444 (2.961) | 0.009 (0.383) | 0.574 (3.513) |
| LnID | -0.445 (1.947) | 0,244 (0.340) | -0.473 (1.78) | -0.397 (1.443) | -0.690 (1.521) | -0.527 (1.760) |
| Adj.R2 | 0.31 | 0.013 | 0.25 | 0.06 | 0.005 | 0.10 |

Note: IIT = intra-industry trade; HIIT = horizontal intra-industry trade; VIIT = vertical intra- industry trade. The absolute value of the t-statistics are in parentheses. Each regression contains 88 observations.

Table 6:
OLS and fixed effects regressions on the shares of intra-industry trade with the Czech Republic

| Dependent variable | (1) Total IIT(A) | (1a) Total IIT(A) | (2a) HIIT(A) | (2a) HIIT(A) | (3a) VIIT(A) | (3a) VIIT(A) |
|---|---|---|---|---|---|---|
| Constant | -8.91 (1.906) | -14.74 (2.72) | 3.669 | | -10.540 (2.236) | -17.540 |
| ln\| $GDPC_{EU}$-$GDPC_{TE}$\| | 0.50 (1.616) | 0.861 (2.453) | 2.302 (1.703) | | 0.432 (1.386) | 0.865 (2.560) |
| ln maxGDP | 0.391 (4.692) | 0.274 (2.717) | 0.187 (0.584) | | 0.409 (4.875) | 0.268 (2.762) |
| ln min GDP | -0.153 (0.391) | 0.181 (0.441) | -3.031 (2.048) | | 0.0031 (0.081) | 0.434 (1.096) |
| LnID | | -0.760 (1.839) | | | | -0.913 (2.294) |
| Adj. R2 | 0.48 | 0.54 | 0.16 | | 0.50 | 0.60 |

Note: IIT = intra-industry trade; HIIT = horizontal intra-industry trade; VIIT = vertical intra-industry trade. The absolute value of the t-statistics are in parentheses.

## Annex: Data and methods

*(1) Trade*

We use data from the Combined Nomenclature (CN) of EUROSTAT. This dataset enables the decomposition of product groups according to their degree of explicit liberalisation by hand of the European Agreements, the information source being Annex IV or IVa. The agreements provide a complete list of 8-digit CN chapters when describing the extent and dynamics of agreed trade liberalisation. Since calculation cannot be performed at the 8-digit level (too many zero observations), we chose the 4-digit one.[1] Nevertheless, this product setting seems close to the reality of liberalized and less liberalized trade. The selected chapters stay for about 26 per cent of total EU-TE trade in 1993 and 18 per cent in 1997.

Panel A includes all four-digit CN categories of manufactured goods from CN chapters 30, 33-38, 84, 86, and 88-90 whose trade was almost completely liberalized immediately after the IA with the EU came into effect. For the Czech Republic, we found 100 4-digit items, for Hungary only 29 items, for Poland 81 items and for Slovakia 100 items. Trade between the EU and Hungary is somewhat different concerning panel A: when the interim agreement came into force, custom duties of the Union were not abolished, but were reduced to two-thirds of the basic rate on 1 March 1992, and to one-third on 1 January 1993. Tariffs were abolished from 1994 onwards. Hungary followed the course taken by the other three countries with a one-year delay – which may be responsible for some differences in price-quality gaps and in IIT and VIIT indices.

[1] Zero observations do not mean that there was no trade. Statistical reporting is obliged to some degree of confidence, that is the reader should not be able to identify companies. On the 8-digit level this might be possible. Of course, the 4-digit level restrains somewhat the explanatory merits of the dataset.

Panel B includes 137 four-digit items of the CN chapters 50-63: mainly textiles and clothing. Trade in these items was initially not liberalized (with few exceptions). Liberalization was planned to be completed six years after the agreement came into effect in March 1992, and therefore by the end of 1998. Of course, both panels may include some items, which belong to the other, or even to neither of them.

Panel B data also include subcontracting or outward processing trade (OPT). The share of OPT in total EU imports in textiles and clothing was at 29 per cent in 1996 (*Pellegrin*, 1998). The share in German imports from the four TE countries in chapters 62 and 63 (clothing) was at 75 per cent for both the Czech and Slovak Republics, 85 per cent for Hungary, and 90 per cent for Poland in 1996 (*Möbus*, 1998). OPT played no remarkable role in most of other chapters, particularly 80 to 90. In these 'industries' foreign direct investment seemed to have a more influential role for trade structures than OPT (*Lemoine*, 1998).

The usual procedure (see for example *Greenaway*, *Hine* and *Milner* 1994, and *Aturupane et al.* 1998) for decomposing VIIT and HIIT is the application of relative unit values (RUVs) inside and outside a selected range. A RUV outside the range selected, here: 15 per cent on either side of unity, is not necessarily a quality indicator. The economic theory of index numbers develops the conditions under which a unit value index reflects a change in the quality vector of a bundle of commodities when prices are fixed. When prices are not fixed, quality and cost may have changed. A RUV higher than 1.15 may reflect an export price higher than the import price due to either a cost disadvantage or a quality advantage of the EU.[2] Both scenarios root in completely different worlds: the first approach in the world of perfect competition with homogenous goods where profits tend to zero, and costs determine the price. The second scenario is that of monopolistic competition, hence, differentiated goods where profits are permanent due to quality differences.

One procedure to identify roughly the appropriate advantage in traded items is to link the individual RUVs with the quantities traded, that is the trade balance of the items (*Aiginger*, 1997).[3] We can identify four cases or examples important for our selection procedure:

(1) If the RUV > 1.15 the export unit value exceeds the import unit value. If this gap reflects a quality advantage of the EU, the EU should achieve a trade surplus (despite higher prices). Otherwise, the gap reflects a cost disadvantage of the EU, which is hard to reconcile with an export surplus. Hence, if RUV>1.15, we assume that the EU exports higher quality with respect to imports of the same item. Intra-industry trade is ruled by quality and technology. In this way we can formulate the remaining cases:

(2) If the RUV< 0.85 and the EU has realized a deficit in trade, the TE is assumed to have a quality advantage. In this case, the EU exports goods of lower quality compared with imported goods. Again, intra-industry trade is ruled by quality and technology.

[2] There are, of course, implicit trade barriers as, for example, transfer pricing and false invoicing. A higher price of EU produced items in exports to the TE might reflect those practices. We don't think that this issue will influence the comparison between panels and between HIIT and VIIT. We rather assume that those practice is equally distributed in trade.

[3] A more preferable method – the estimation of price elasticities – requires time series, which, however, are not available.

(3) If the RUV>1.15 and the EU has realized a deficit, the TE is assumed to have a cost advantage. Intra-industry trade is determined by factor endowment and other cost specific factors.

(4) If the RUV<0.85 and the EU has realized a surplus, the EU is assumed to have a cost advantage.

*(2) Income distribution*

*Durkin* and *Krygier* (2000) constructed the income distribution value by cumulating household deciles in a US-OECD framework along with x-axis of the Lorenz curve setting. They set income of the lowest US quintile in PPS as the overlapping income class assuming that household quintiles above this class demand for higher quality and households below demand for lower quality. The alternative would be to calculated along with the y-axis (cumulating income shares up to the dividing quintile/decile). The main problem with both approaches is a possibly severe distortion caused by the incomparability of average incomes in the overlapping income class -- known as the problem of "within" and "between". There might be a shift of the entire distribution frame of the country with given income distribution – an effect better captured by the size variable in the model. Without any change in the income distribution in both countries the distance between average incomes might increase at an extent that any overlapping income class might be get lost. This is the more plausible as in TE countries the period between 1993 and 1997 was characterised by strong income shifts in international currency due to PPS and exchange rate developments.[4] We avoided all kind of income figures in international currencies and calculated decile ratios for each country and relative decile ratios for each country pair in order to catch only the "within" effects. Decile and relative decile ratios are presented in Tables A1 and A2 for both years of comparison. Data were taken from Luxembourg Income Studies (LIS) with the exception of Slovakia and Portugal. For both data were taken from official statistics. Data include in all cases two years of comparison being not necessarily 1993 and 1997 (for example, basis year for Spain was 1981). Data for Ireland include only one year.

[4] To give an example: The average income of the highest decile in Slovakia decreased between 1993 and 1997, and the average income of the lowest decile in the United Kingdom increased (all in PPS terms).

Table A1: Decile ratios and relative decile ratios for the basis year ("1993")

| 1993 | | Czech Republic | Hungary | Poland | Slovak Republic |
|---|---|---|---|---|---|
| | Decile Ratios | 3.80 | 6.76 | 6.94 | 3.44 |
| Austria | 4.61 | 0.83 | 1.47 | 1.50 | 0.75 |
| Belgium | 4.25 | 0.90 | 1.59 | 1.63 | 0.81 |
| Denmark | 5.22 | 0.73 | 1.30 | 1.33 | 0.66 |
| Finland | 4.19 | 0.91 | 1.62 | 1.66 | 0.82 |
| France | 7.60 | 0.50 | 0.89 | 0.91 | 0.45 |
| Germany | 5.28 | 0.72 | 1.28 | 1.31 | 0.65 |
| Ireland | 8.59 | 0.44 | 0.79 | 0.81 | 0.40 |
| Italy | 6.53 | 0.58 | 1.04 | 1.06 | 0.53 |
| Netherlands | 6.38 | 0.60 | 1.06 | 1.09 | 0.54 |
| Sweden | 5.11 | 0.74 | 1.32 | 1.36 | 0.67 |
| Spain | 8.75 | 0.43 | 0.77 | 0.79 | 0.39 |
| UK | 9.04 | 0.42 | 0.75 | 0.77 | 0.38 |
| *means* | *6.29* | *0.65* | *1.16* | *1.19* | *0.59* |

Source: Own calculations based upon LIS data (except Slovakia); Slovakia: Statistical Office of the Slovak Republic, 1999.

Note: For decile ratios, income shares of $10^{th}$ over $1^{st}$ deciles in individual countries.

Table A2: Decile ratios and relative decile ratios for the year of comparison ("1997")

| 1997 | | Czech Republic | Hungary | Poland | Slovak Republic |
|---|---|---|---|---|---|
| | Decile Ratios | 5.21 | 8.97 | 10.54 | 4.48 |
| Austria | 7.36 | 0.71 | 1.22 | 1.43 | 0.61 |
| Belgium | 5.70 | 0.91 | 1.57 | 1.85 | 0.79 |
| Denmark | 4.43 | 1.18 | 2.02 | 2.38 | 1.01 |
| Finland | 4.43 | 1.18 | 2.02 | 2.38 | 1.01 |
| France | 6.53 | 0.80 | 1.37 | 1.61 | 0.69 |
| Germany | 6.03 | 0.87 | 1.49 | 1.75 | 0.74 |
| Ireland | 8.59 | 0.61 | 1.04 | 1.23 | 0.52 |
| Italy | 11.59 | 0.45 | 0.77 | 0.91 | 0.39 |
| Netherlands | 6.42 | 0.81 | 1.40 | 1.64 | 0.70 |
| Sweden | 5.25 | 0.99 | 1.71 | 2.01 | 0.85 |
| Spain | 7.61 | 0.68 | 1.18 | 1.38 | 0.59 |
| UK | 10.00 | 0.52 | 0.90 | 1.05 | 0.45 |
| *means* | *6.99* | *0.81* | *1.39* | *1.64* | *0.70* |

Source: Own calculation based upon LIS data (except Slovakia); Slovakia: Statistical Office of the Slovak Republic, 1999.

Note: For decile ratios, income shares of $10^{th}$ over $1^{st}$ deciles in individual countries.